



Senior Design 1 Product Abstract

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Senior Design 1

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Active Trad Gear

People have climbed for millennia, but only in recent years has rock climbing acquired recognition as a legitimate sport. Modern rock-climbing culture is centralized on pushing one's limits to the extreme. As such, falling is an eventuality for those seeking a challenge. Luckily, falling is not a death sentence for the modern climber. Protective equipment has advanced in parallel with human ability, and fall-arresting gear is now widely available to the public.

One of the most popular types of protective climbing gear is the cam (*figure 1*). As they are now manufactured by numerous companies, cams designs vary, but all function in essentially the same manner. Four downward-curving lobes are mounted in an array on a central axle. Springs attach to the lobes to ensure constant expansion. A wire is run from each lobe to a handle that disengages the cam when pulled. While disengaged, the cam is placed into a crack and then allowed to expand until each independently moving lobe firmly contacts the stone (*figure 2*). When loaded, the lobe's curving profiles force them to expand in the crack. This expansion exerts extreme compressive forces on the wall which, in turn, keeps it locked in place.

Although effective and simplistically elegant, there are shortcomings to the design. Compressive forces may be a good thing when stopping a fall, but they can make loaded cams infuriatingly difficult to retrieve. Removal is a convoluted process in which the lobes are disengaged by pulling the handle while pushing the cam deeper into the crack. This motion is, at best, difficult in ideal circumstances and nearly impossible if the cam is placed in a crack with poor access. Unfortunately, permanently wedged trad gear is a relatively common sight. In addition to being expensive, losing cams is a safety concern. Climbers can easily become stranded if they lose their gear on a large wall. While losing a cam is always unfortunate, the phenomenon of "cam walk" is a more pressing concern. Cams are designed to support tensile loads by inducing bilateral compression. They work splendidly providing they are not loaded in torsion. However, falls are not always controllable, and rock is not always solid. As such, a bad fall can cause a cam to rotate until it no longer engages the crack. Over the relatively brief period of climbing as a sport, dislodged trad gear has claimed many lives; and the ever-present risk of a fatal fall makes trad climbing one of the most extreme variants of the sport.

We propose to overcome these issues by creating a cam-inspired piece of trad gear that is easier to remove after stopping a fall, and less likely to "walk" out of a crack. To facilitate removal, we intend to exchange the cable and handle system for an internally routed compressively activated release. Internally routing and extending the release will protect it from wear and improve access in cramped conditions. Incorporating a compressive system will serve a two-fold purpose of making an accidental release less probable while streamlining removal. Rather than pulling the lever and pushing the cam at the same time, removal will involve one pushing motion. The compressive release will incorporate a strike plate that, when struck with

the palm, simultaneously disengages the lobes while delivering impulsive forces. We intend to overcome cam walk by using a minimum of six lobes that are arranged radially around a central hub. Having more lobes in a radial arrangement will hopefully provide some insurance. That is, the cam can walk out of its original placement, but a new lobe will always contact the wall.

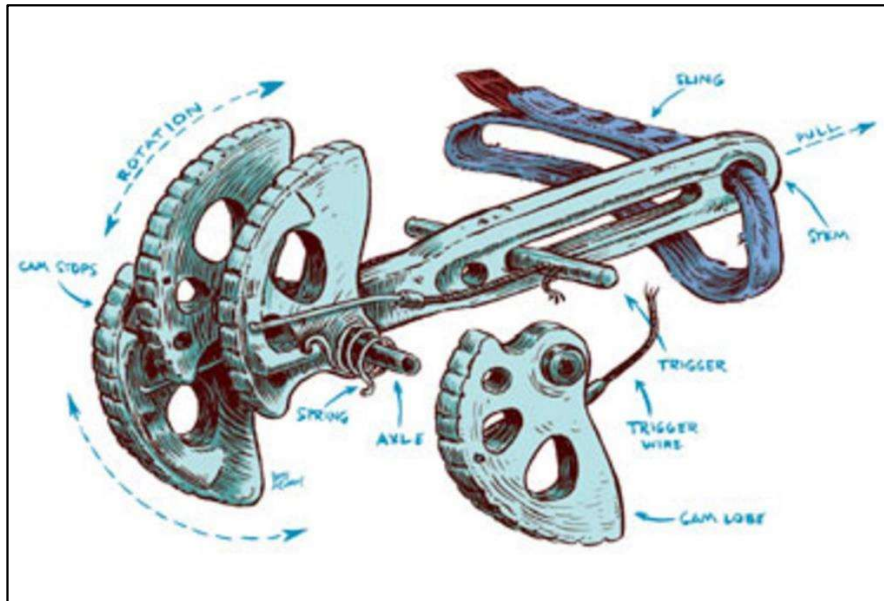


Figure 1 – Artist's Depiction of a Typical Cam.



Figure 2 – Cam Engaged in a Crack

